

# Anemias

## in the mirror of the real clinical cases

LECTURE IN INTERNAL MEDICINE FOR IV COURSE STUDENTS

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# Plan of the lecture

- Definition
- Epidemiology
- Etiology & Mechanisms
- Adaptation to anaemia
- Classification
- Clinical investigation
- Diagnosis
- Treatment
- Prognosis
- Prophylaxis
- Abbreviations
- Diagnostic guidelines



# Definition

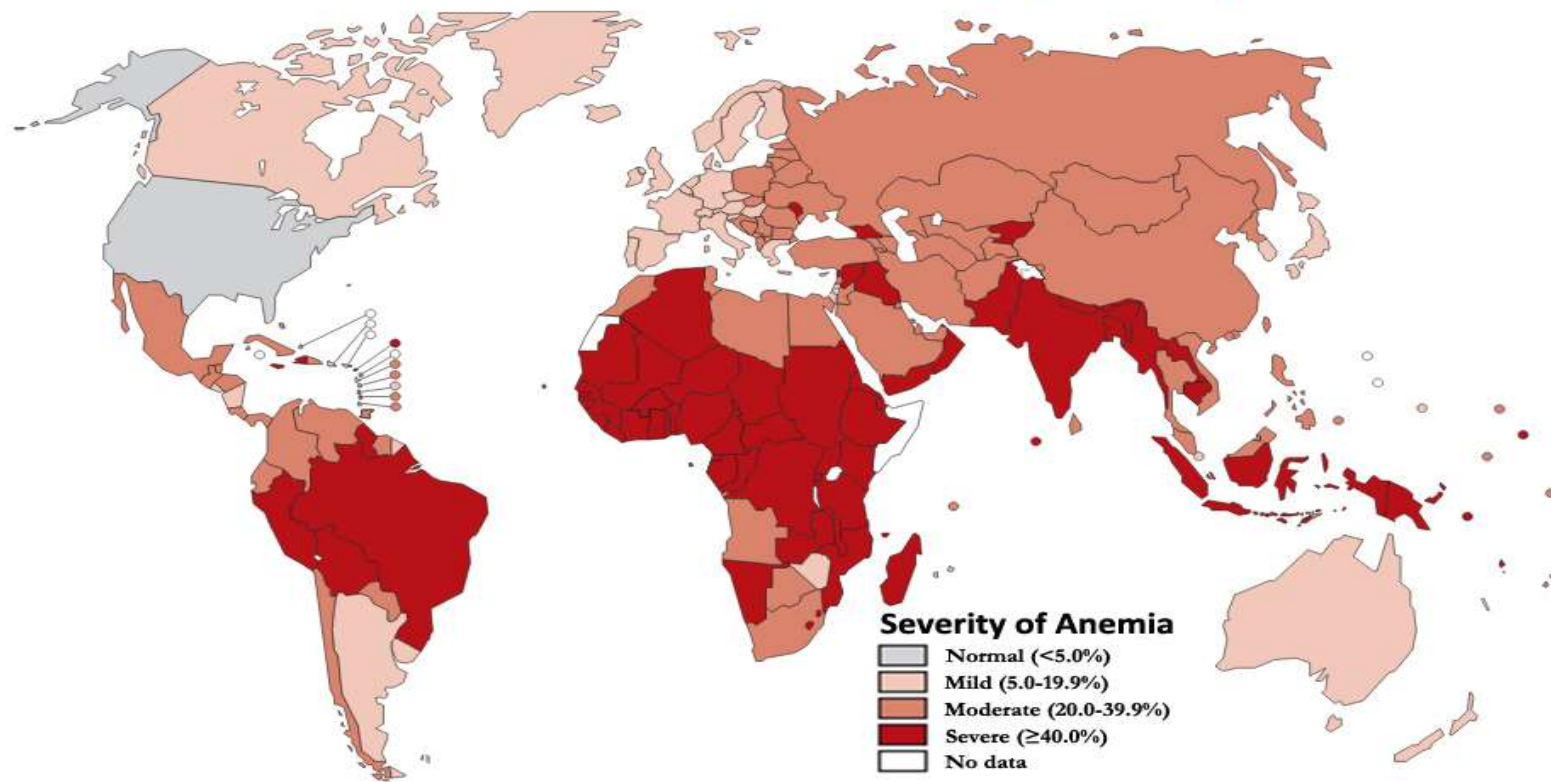
Anemia is a disease and/or a clinical syndrome that consist in lowered ability of the blood to carry oxygen (hypoxia) due to decrease quantity and functional capacity and/or structural disturbances of red blood cells (RBCs) or decrease hemoglobin concentration or hematocrit in the blood

A severe form of anemia, in which the hematocrit is below 10%, is called the hyperanemia

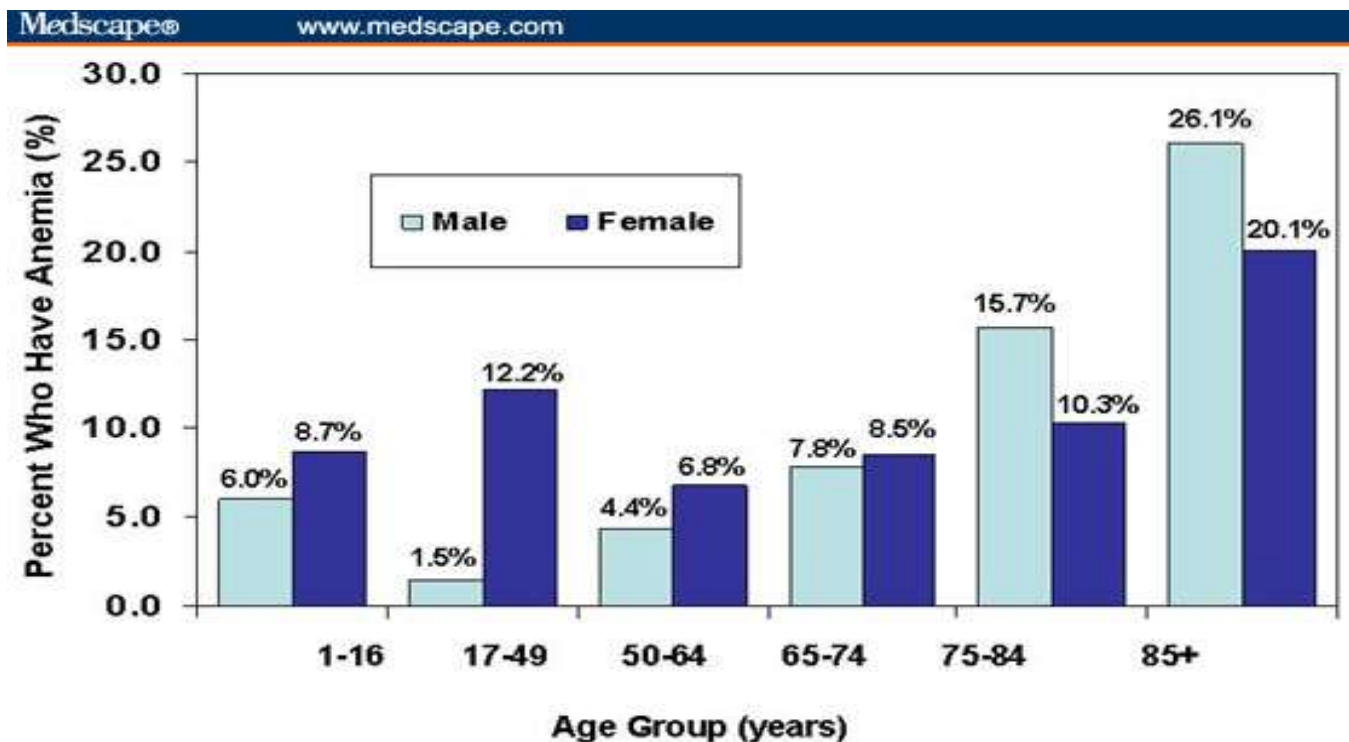
*WHO criteria is  $Hb < 13 \text{ g/dL}$  in men and  $Hb < 12 \text{ g/dL}$  in women (revised criteria for patient's with malignancy  $Hb < 14 \text{ g/dL}$  in men and  $Hb < 12 \text{ g/dL}$  in women)*

# Epidemiology 1

## Worldwide Prevalence of Anemia, by severity



# Epidemiology 2

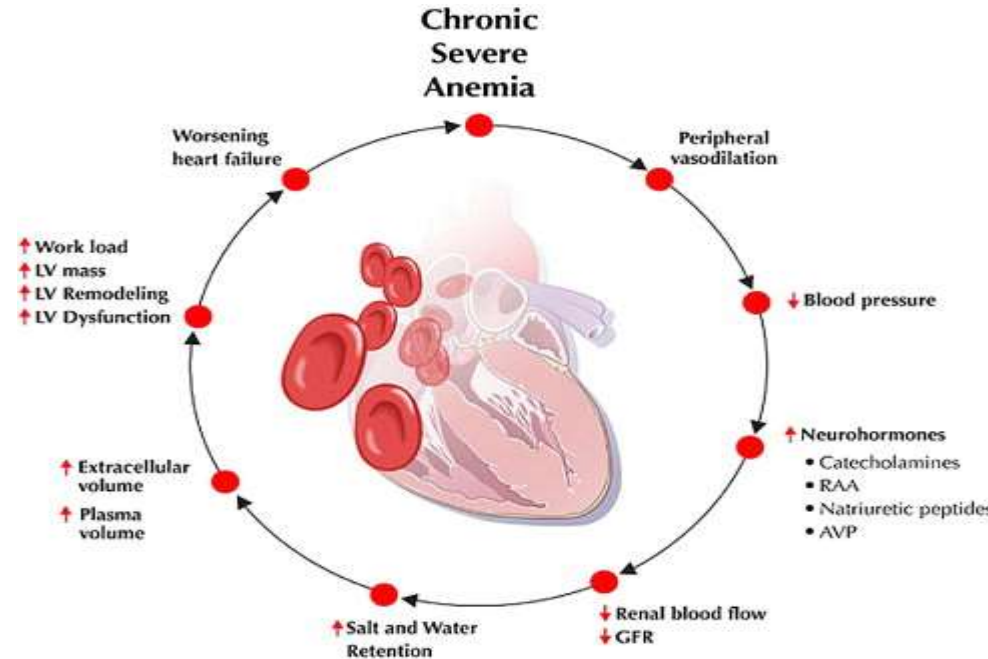


# Etiology & Mechanisms 1

## (basic forms)

### Basic forms

- Blood loss
- Deficient erythropoiesis
- Excessive hemolysis (RBC destruction)
- Fluid overload (hypervolemia)



# Etiology & Mechanisms 2

## (causes of anemia)

- Blood loss: acute, chronic
- Deficient erythropoiesis: microcytic, normochromic-normocytic, macrocytic
- Excessive hemolysis due to extrinsic RBC defects
- Reticuloendothelial hyperactivity with splenomegaly
- Immunologic abnormalities
- Mechanical injury
- Excessive hemolysis due to intrinsic RBC defects
- Membrane alterations, acquired
- Membrane alterations, congenital
- Metabolic disorders (inherited enzyme deficiencies)
- Hemoglobinopathies

# Classification (morphological)

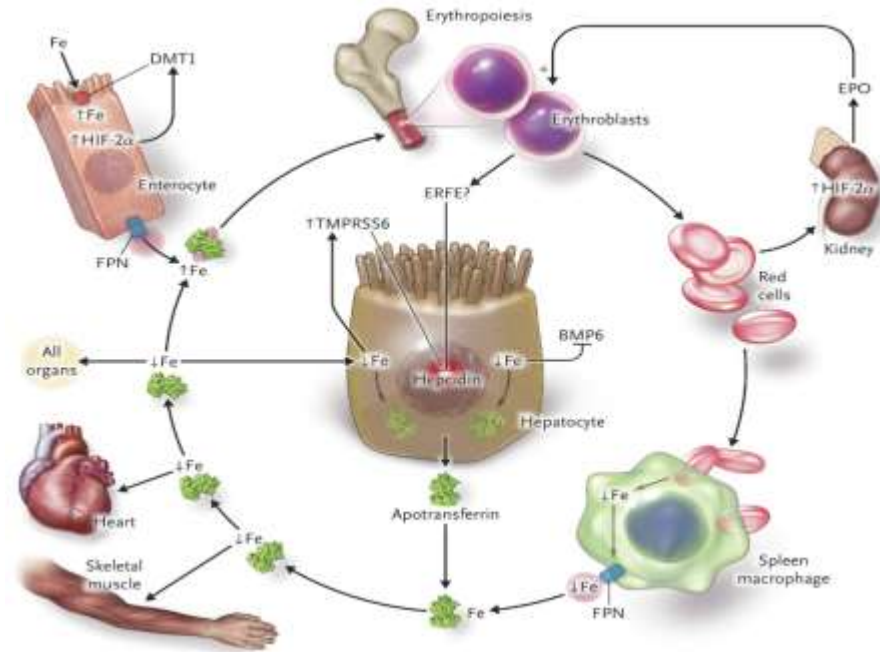
Cell Size	Normal RDW	High RDW
<b>Microcytosis</b> <b>MCV&lt;70 <math>\mu\text{m}^3</math></b>	Thalassemia minor, anemia of chronic disease, some hemoglobinopathy traits	Iron deficiency, hemoglobin H disease, some anemia of chronic disease, some thalassemia minor, fragmentation hemolysis
<b>Normocytosis:</b> High reticulocyte count Low reticulocyte count	Anemia of chronic disease, hereditary spherocytosis, some hemoglobinopathy traits, acute bleeding	Early or partially treated iron or vitamin deficiency, sickle cell disease
<b>Macrocytosis</b> <b>MCV&gt;100 <math>\mu\text{m}^3</math></b>	Aplastic anemia, some myelodysplasias	Vitamin B12 or folate deficiency, autoimmune hemolytic anemia, cold agglutinin disease, some myelodysplasias, liver disease, thyroid disease, alcohol

**RDW = red cell distribution width; MCV = mean corpuscular volume**



# Classification (clinical)

- Alpha Thalassemia
- Anemia of chronic disease
- Aplastic Anemia
- Beta Thalassemia
- Hemolytic Anemia
- Iron Deficiency Anemia
- Megaloblastic Anemia
- Myelophthistic Anemia
- Pernicious Anemia
- Sickle Cell Anemia
- Spur Cell Anemia



Iron-deficiency anemia is the most common form of anemia in the world

# Clinical investigation

## (symptoms)

- Easy fatigue and loss of energy
- Unusually rapid heart beat, particularly with exercise
- Shortness of breath, particularly with exercise
- Pale skin
- Leg cramps
- Coldness in the hands and feet
- Insomnia
- Light-headedness
- Faintness
- Signs of heart failure

# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 1)

- A 23-year-old woman with known depression, taking antidepressant medications, presented to emergency department with a 1-month history of chest discomfort on exertion, palpitation, light headedness and generalised fatigability.

# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 2)

- Patient denied any history of loss of consciousness, significant shortness of breath, bleeding from any site, black discolouration of stools or bleeding per rectum, abdominal pain, or change in bowel habit.
- She had no history of weight loss or anorexia and had no eating disorder, and she did not crave unusual foodstuffs.

# Clinical case

## (Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 3)

- Patient's medical history was significant for depression, which began with the loss of her mother 4 years previously, but she had no history of any other chronic medical illness or hospital admission.
- Her gynaecological history was notable for secondary amenorrhoea for the previous 6 months.
- She stated that she had been eating well (three meals/day) and that she rarely went outdoors or engaged in activities.

# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 4)

- On arrival to the emergency department, vitals were as follows: blood pressure, 91\51 mm Hg; heart rate, 115 bpm; temperature, 36°C; oxygen saturation, 96% on room air; and respiratory rate, 22 breaths/min.
- Patient appeared pale without evidence of jaundice, had a thin build (body mass index of 21 kg/m<sup>2</sup>) and seemed depressed, fatigued and uninterested in conversation.

# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 5)

- Chest and heart examination findings were normal.
- The patient's abdomen was soft and lax with no tenderness, hepatosplenomegaly, or palpable masses, and a rectal examination was negative for melena.
- Doctors noticed that her head was covered with lice, and lice nits were visible.
- Examination of the scalp revealed scratch marks; no lice were seen on the rest of the body.

# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 6)

- The patient's complete blood count showed a haemoglobin level of 2.2 g/L, hematocrit of 12%, mean corpuscular volume of 60 mm<sup>3</sup>, mean corpuscular haemoglobin of 19.7 pgm, platelet count of 405 000 μL, white cell count of 7.3×10<sup>3</sup>/mm<sup>3</sup>, lactate dehydrogenase level of 83 IU/L, total bilirubin level of 0.6 mg/dL, albumin level of 3.4 g/dL and normal liver function.



# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 7)

- ECG showed regular sinus tachycardia with no ST-segment changes.
- Cardiac enzymes were within normal limits.
- A peripheral blood film showed severe microcytic hypochromic anaemia with mild anisocytosis and adequate platelet numbers.

# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 8)

- A pregnancy test was negative, three fecal occult blood tests came back negative and abdominopelvic ultrasound was normal except for a borderline enlarged spleen of 12.8 cm.
- The patient's ferritin level was 1.19 ng/ dL, serum iron level 3 µg/dL, vitamin B12 level 523.8 pg/mL, folate level 8.8 ng/dL and haemoglobin electrophoresis was normal.

# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 9)

- After receiving 2 units of packed red blood cells, the patient's haemoglobin level rose to 5 g/L.
- She was treated with permethrin 0.4% and shampoo for the head lice and intravenous iron therapy for the anaemia.
- After ensuring good body hygiene and psychological therapy, she began to communicate more and exhibit improvement in her symptoms.

# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 10)

- The patient was discharged with a haemoglobin level of 6 g/L, oral iron and folic acid supplements and instructions to return to the outpatient clinic after 1 month.
- Unfortunately, she did not return for follow-up, and attempts to contact her failed.

# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 11)

- Iron deficiency anaemia is prevalent among young females, in whom chronic blood loss is the most common cause (eg, menstrual blood loss, gastrointestinal bleeding).
- Other causes of iron deficiency anaemia are dietary insufficiency or decreased iron absorption.

# Clinical case

(Severe iron deficiency anaemia associated with heavy lice infestation in a young woman 12)

- This patient presented with severe iron deficiency anaemia.
- Her history and laboratory investigation findings did not reveal any obvious condition as the underlying cause of her anaemia, however, physical examination revealed a heavy and chronic head lice infestation.
- Severe iron deficiency in the presence of heavy lice infestation is believed to occur secondary to chronic blood loss, and a greater chronicity and quantity of lice can lead to a significant drop in haemoglobin.

# Clinical investigation

(symptoms: anemia caused by iron deficiency)

- A hunger for strange substances such as paper, ice, or dirt (a condition called pica)
- Upward curvature of the nails, referred to as koilonychias
- Soreness of the mouth with cracks at the corners



Pica



Koilonychia

# Clinical investigation

(symptoms: anemia caused by vitamin B12 deficiency)

- A tingling, "pins and needles" sensation in the hands or feet
- Lost sense of touch
- A wobbly gait and difficulty walking
- Clumsiness and stiffness of the arms and legs
- Dementia



Hand stiffness



# Clinical investigation

(symptoms: anemia caused by chronic lead poisoning)

- A blue-black line on the gums referred to as a lead line
- Abdominal pain
- Constipation
- Vomiting



A blue-black line on the gums referred to as a lead line

# Clinical investigation

(symptoms: anemia caused by chronic red blood cell destruction)

- Jaundice (yellow skin and eyes)
- Brown or red urine
- Leg ulcers
- Failure to thrive in infancy
- Symptoms of gallstones

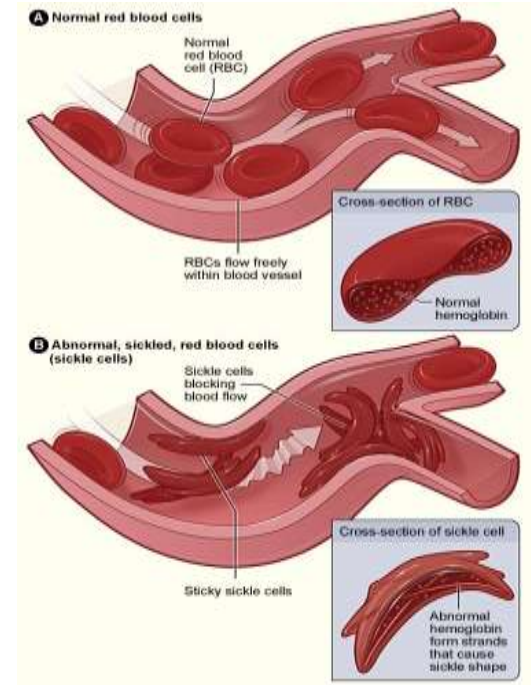


Yellow around eyes anemia

# Clinical investigation

(symptoms: sickle cell anemia)

- Fatigue
- Susceptibility to infection
- Delayed growth and development in children
- Episodes of severe pain, especially in the joints, abdomen, and limbs



Sickle cell anemia

# Clinical investigation

(symptoms: anemia caused by sudden red blood cell destruction)

- Abdominal pain
- Brown or red urine
- Jaundice (yellow skin)
- Small bruises under the skin
- Seizures
- Symptoms of kidney failure



The bruise under the skin

# Clinical investigation

## (accents on history 1)

- The duration of anemia can be established by obtaining a history of previous blood examinations and, if necessary, by acquiring those records
- Similarly, a history of rejection as a blood donor or prior prescription of hematinic provides clues that anemia was detected previously

# Clinical investigation

## (accents on history 2)

- Obtain a family history for anemia, jaundice, cholelithiasis, splenectomy, bleeding disorders, and abnormal Hbs
- Document the patient's occupation, hobbies, prior medical treatment, drugs (including over-the-counter medications and vitamins), and household exposures to potentially noxious agents (insecticides, paints, solvents, hair dyes)

# Clinical investigation

(accents on history 3)

- In searching for blood loss, carefully document pregnancies, abortions, and menstrual loss
- Patients do not appreciate the significance of tarry stools, but changes in bowel habits can be useful in uncovering neoplasms of the colon
- Hemorrhoidal blood loss is difficult to quantify, and it may be overlooked or overestimated from one patient to another

# Clinical investigation

(accents on history 4)

- Seek a history of gastrointestinal (GI) complaints that may suggest gastritis, peptic ulcers, hiatal hernias, or diverticula
- Abnormal urine color can occur in renal and hepatic disease and in hemolytic anemia
- A dietary history must include foods that the patient eats and those that he/she avoids, as well as an estimate of their quantity



# Clinical investigation

(accents on history 5)

- Changes in body weight are important with regard to dietary intake and can suggest the presence of malabsorption or an underlying wasting disease of infectious, metabolic, or neoplastic origin
- Obtain a history of fever or identify the presence of fever, because infections, neoplasms, and collagen vascular disease can cause anemia

# Clinical investigation

## (accents on history 6)

- The occurrence of purpura, ecchymoses, and petechiae suggest the occurrence of either thrombocytopenia or other bleeding disorders; this may be an indication either that more than 1 bone marrow lineage is involved or that coagulopathy is a cause of the anemia because of bleeding
- Cold intolerance can be an important symptom of hypothyroidism or lupus erythematosus, paroxysmal cold hemoglobinuria, and certain macroglobulinemias

# Clinical investigation

(accents on history 7)

- The relation of dark urine to either physical activity or time of day can be important in march hemoglobinuria and paroxysmal nocturnal hemoglobinuria
- Explore the presence or the absence of symptoms suggesting an underlying disease, such as cardiac, hepatic, and renal disease; chronic infection; endocrinopathy; or malignancy
- A geographic history can also be important in establishing an etiology

# Clinical investigation

(accents on physical examination 1a)

- The skin and mucous membranes are often bypassed, so that pallor, abnormal pigmentation, icterus, spider nevi, petechiae, purpura, angiomas, ulcerations, palmar erythema, coarseness of hair, puffiness of the face, thinning of the lateral aspects of the eyebrows, nail defects, and a usually prominent venous pattern on the abdominal wall are missed in the rush to examine the heart and the lungs

# Clinical investigation

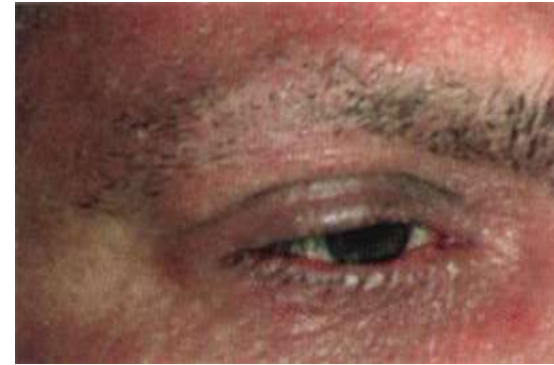
(accents on physical examination 1b)



Purpura



Spider nevi



Thinning of the lateral  
aspects of the eyebrows

# Clinical investigation

## (accents on physical examination 2)

- Examine optic fundi carefully but not at the expense of the conjunctivae and the sclerae, which can show pallor, icterus, splinter hemorrhages, petechiae, comma signs in the conjunctival vessels, or telangiectasia that can be helpful in planning additional studies
- Perform systematic examination for palpable enlargement of lymph nodes for evidence of infection or neoplasia

# Clinical investigation

(accents on physical examination 3a)

- Bilateral edema is useful in disclosing underlying cardiac, renal, or hepatic disease, whereas unilateral edema may portend lymphatic obstruction due to a malignancy that cannot be observed or palpated
- Carefully search for hepatomegaly and splenomegaly because in patients with chronic disorders, these organs are firm, nontender, and nonnodular, and in patients with carcinoma, they may be hard and nodular

# Clinical investigation

(accents on physical examination 3b)



Massive hepatosplenomegaly in a patient with severe malarial anemia due to *Plasmodium falciparum* infection



# Clinical investigation

(accents on physical examination 4)

- A rectal and pelvic examination cannot be neglected, because tumor or infection of these organs can be the cause of anemia
- The neurologic examination should include tests of position sense and vibratory sense, examination of the cranial nerves, and testing for tendon reflexes

# Clinical investigation

(accents on physical examination 5)

- The heart should not be ignored, because enlargement may provide evidence of the duration and the severity of the anemia, and murmurs may be the first evidence of infective endocarditis that could explain the etiology of the anemia

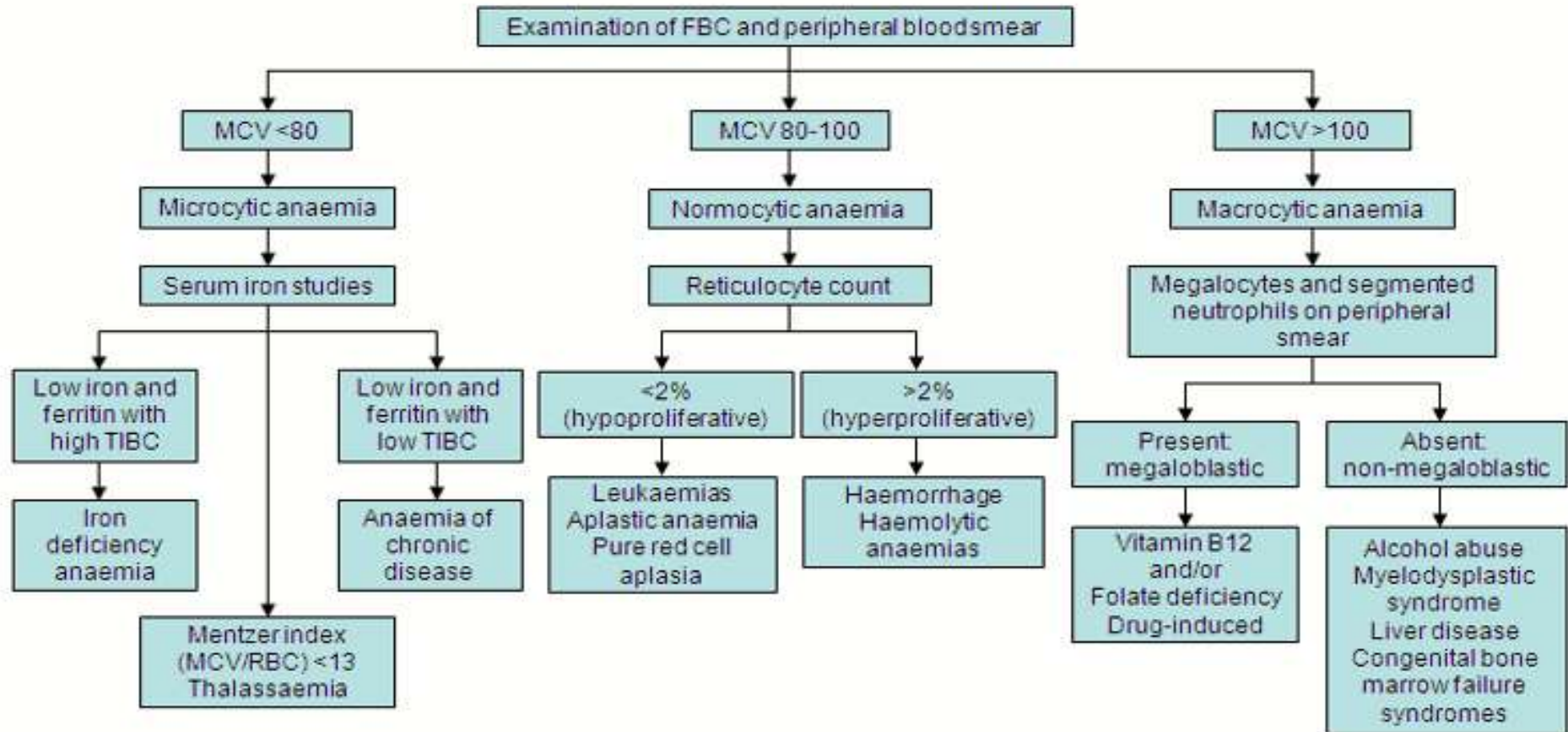
# Diagnosis

## initial assessment

- Patients may present in several ways
- The urgency with which anemia is evaluated depends on the severity at presentation
- Patients with an acute severe hemorrhage present with hypovolaemia and symptoms and signs of the underlying cause
- Many patients with no acute or active bleeding are asymptomatic, and the anaemia is only noted on a full blood count (FBC) taken as part of the assessment of an unrelated condition
- The first step in diagnosis is to identify the type of anemia that is present, using the results of the FBC

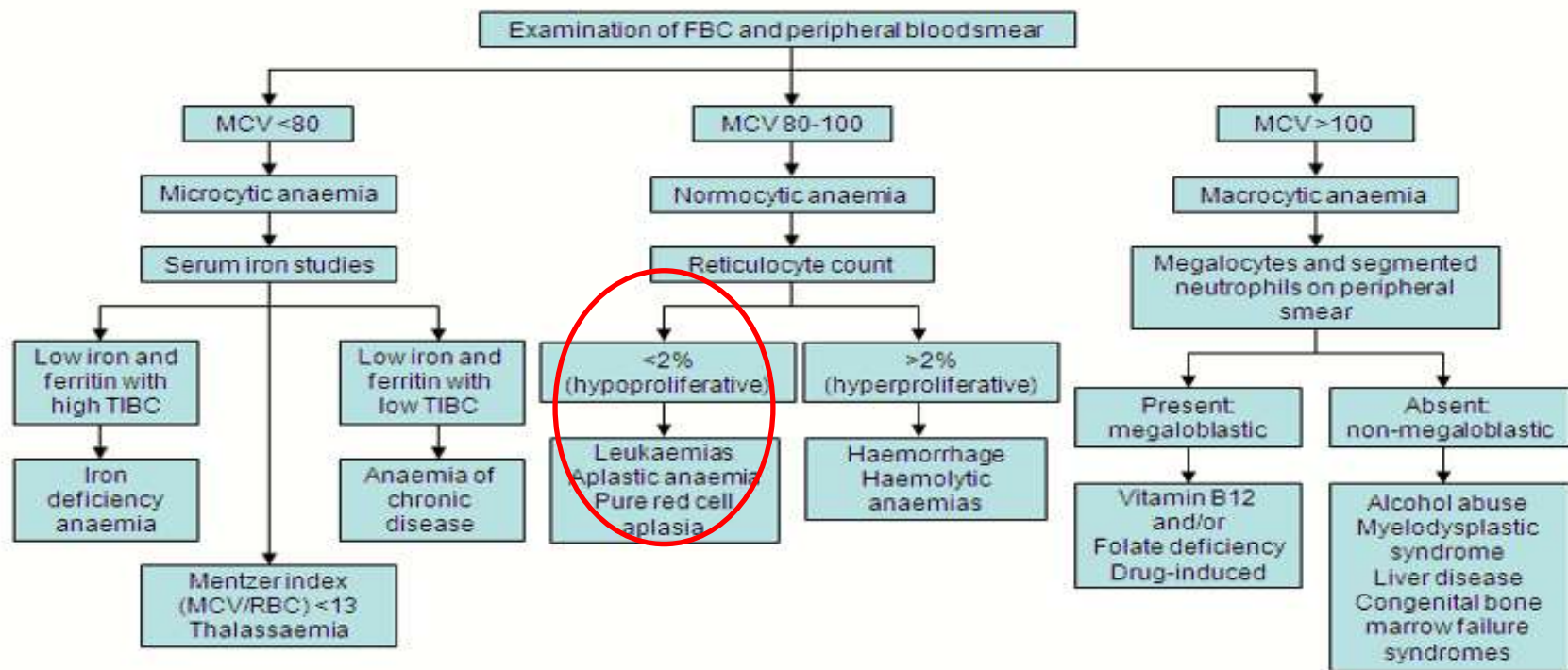
# Diagnosis

## algorithm for the assessment of anemia



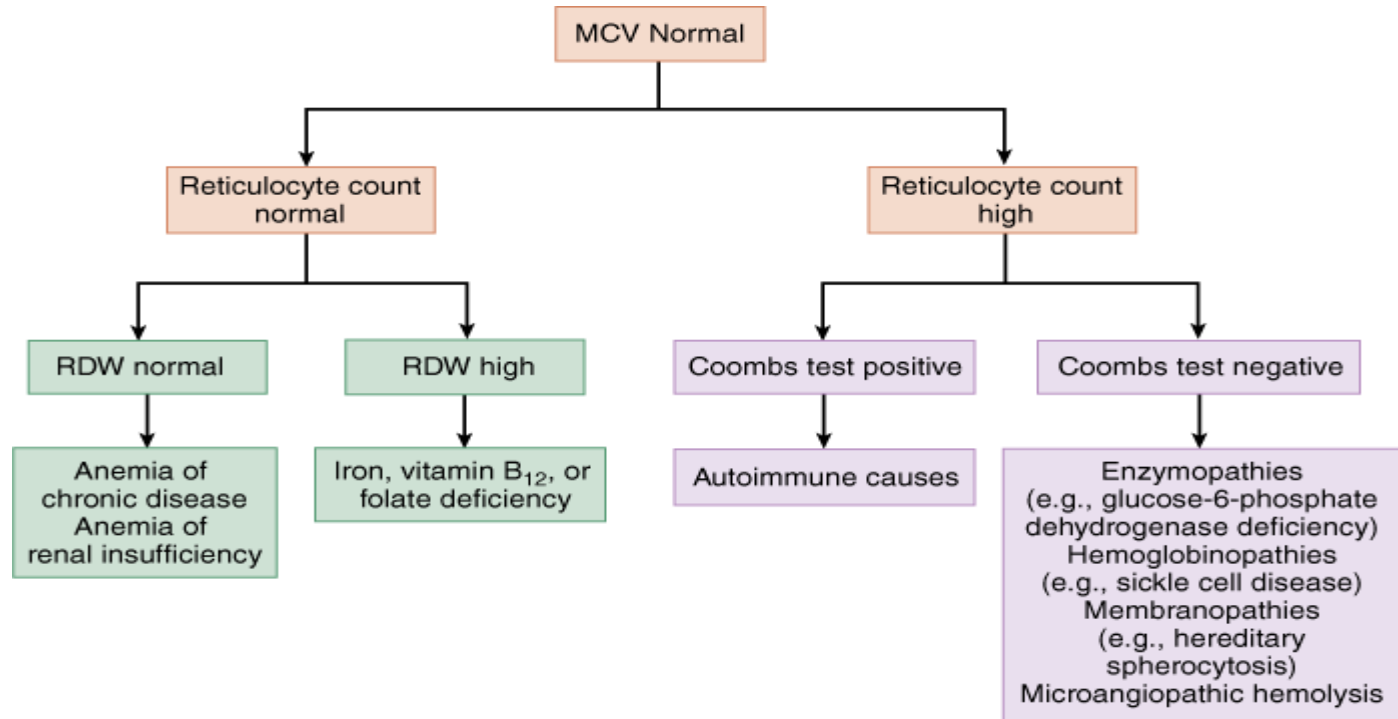
# Diagnosis

## normocytic anemia: hypoproliferative



# Diagnosis

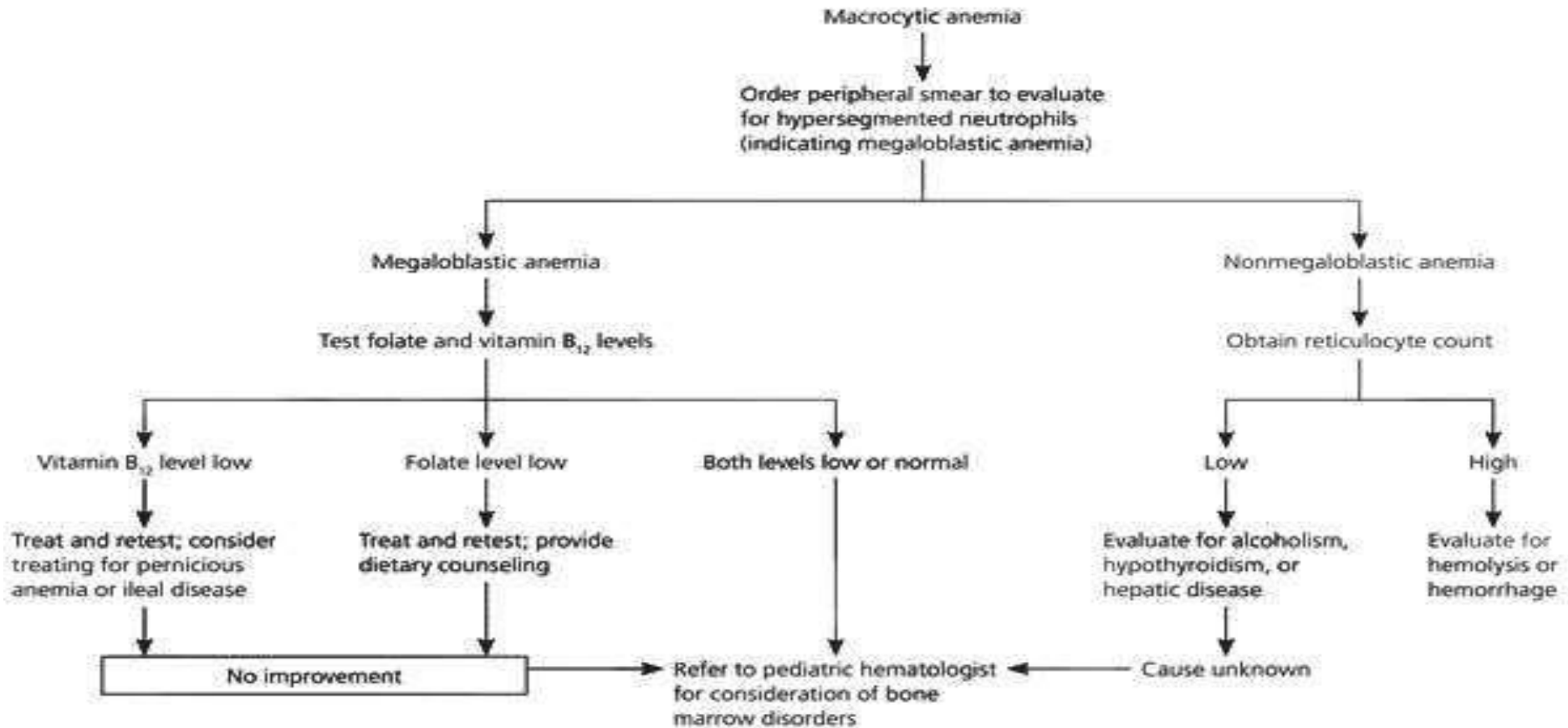
## normocytic anemia: hyperproliferative



Source: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Cydulka RK, Meckler GD:  
*Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th Edition*;  
<http://www.accessmedicine.com>  
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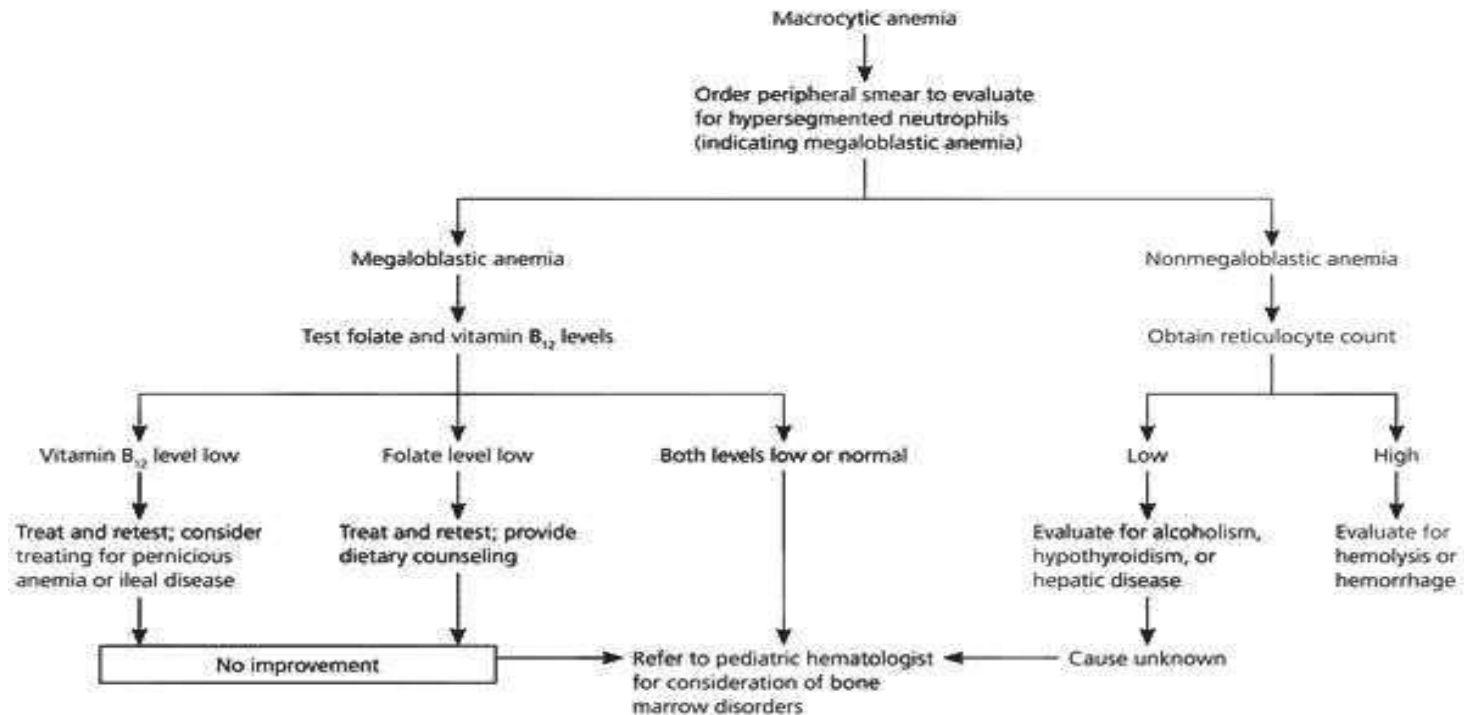
# Diagnosis

## macrocytic anemia: megaloblastic



# Diagnosis

## macrocytic anemia: megaloblastic





# Clinical case

## (Anemia due to Iron Deficiency and Chronic Disease 1)

- A 58-year-old African American male (AAM) was admitted from a nursing home (NH) with a chief complaint (CC) of being lethargic and not acting appropriately
- The patient stated that his legs hurt, and they had been hurting for a long time

# Clinical case

## (Anemia due to Iron Deficiency and Chronic Disease 2)

- Diabetes mellitus type II (DM), hypertension (HTN), venous stasis ulcers, anemia, hepatitis C, peripheral vascular disease (PVD), congestive heart failure (CH)
- Bilateral lower extremity (B) LE) stasis ulcers status post (S/P) debridement and multiple failed skin grafts 2 years ago, a right hallux amputation
- Acetaminophen, zolpidem, hydrocodone, FeSO<sub>4</sub>, clonidine, amitriptyline, oxycodone, insulin glargine, furosemide, metformin, pioglitazone, metoprolol
- Remote history of heroin and cocaine abuse, former smoker and drinker.

# Clinical case

(Anemia due to Iron Deficiency and Chronic Disease 3)



A diabetic patient with (B) infected stasis ulcers

# Clinical case

## (Anemia due to Iron Deficiency and Chronic Disease 4)

Physical examination:

- VS: BT-HR-BR-BP - 38-126-24-137/81
- Chest: Clear To Auscultation Bilaterally - CTA (B)
- CVS: tachycardic but regular with no murmurs
- Abdomen: Soft, nontender - NT, nondistended - ND, Bowel Sounds +BS
- Extremities: severe venous stasis ulcers of the lower extremities (B)
- Neuro: AAO x 2, No focal neurological deficits apart from diminished sensation on (B) LE

# Clinical case

(Anemia due to Iron Deficiency and Chronic Disease 5)

HEME	WBC	RBC	HGB	HCT	MCV	MCH	MCHC	RDW	PLT	MPV
0600	15.0#	3.52	8.5L	25.8L	73.3L	24.3L	33.1	18.6H	483H	6.8L
0925	15.5H	3.44L	8.3L	24.9L	72.3L	24.1L	33.4	18.4H	522H	6.4L
0647	21.5H	3.09L	7.6C	21.9L	70.7L	24.5L	34.6	18.4H	592H	6.8L
1206	17.1#	3.77	8.8#	26.7L	70.8#	23.4L	33.0	18.5H	598#	6.7L

CHEMPROFIL	NA	K	CL	CO2	GLUC	BUN	CREAT	TP	ALB	CA	BILI	AST	ALT	ALK P
0600	139	4.7#	107	25	93#	27H	1.7H			8.3L				
1620		5.6→												
0925	139	4.9	105	24	36C	41H	2.1#			8.2L				
1547		5.3H												
0647	134L	5.3H	100	22	55#	51H	2.8→			8.6				
1206	128L	5.2H	95L	20L	172H	51#	3.5H	8.5H	1.5L	8.9	0.2	49H	38	50

CHEMPROFIL	MG	PALB
0600	1.7L	
0925	1.9	
0647	1.9	8.9L

CARDIAC	CK	CK MB	RI	TROP
↓ 0647	173#	1.5	0.9C	< 0.04C

# Clinical case

## (Anemia due to Iron Deficiency and Chronic Disease 6)

Test	Result	Flag	Reference
<b>CBC W/DIFF</b>			
WBC	17.1	# H	3.9-11.0 K/u1
RBC	3.77		3.5-5.5 M/uL
HGB	8.8	# L	14.0-16.5 gM/dl
HCT	26.7	L	39.0-55.0 %
MCV	70.8	# L	80.0-100.0 fL
MCH	23.4	L	25.4-34.6 pg
MCHC	33.0		32.0-36.0 g/dL
RDW	18.5	H	11.5-14.5 %
PLT	598	# H	140-440 K/uL
MPV	6.7	L	7.4-10.4 fL
<b>MANUAL DIFF</b>			
TOTAL CELLS	100		#CELLS
NEUTROPHIL	69		40-80 %
BAND NEUT	11	H	0-5 %
MYELOCYTE	2	H	0-0 %
LYMPHOCYTE	10	L	20-50 %
MONOCYTE	7		2-12 %
EOSINOPHIL	1		0-5 %
<b>RBC MORPH</b>			
POIKILOCYTOSIS	2+		
ANISOCYTOSIS	2+		
TARGET CELLS	1+		



# Clinical case

## (Anemia due to Iron Deficiency and Chronic Disease 7)

Test	Result	Flag	Reference
<b>CBC W/DIFF</b>			
WBC	17.1	# H	3.9-11.0 K/uL
RBC	3.77		3.5-5.5 M/uL
HGB	8.8	# L	14.0-16.5 gM/dl
HCT	26.7	L	39.0-55.0 %
MCV	70.8	# L	80.0-100.0 fL
MCH	23.4	L	25.4-34.6 pg
MCHC	33.0		32.0-36.0 g/dL
RDW	18.5	H	11.5-14.5 %
PLT	598	# H	140-440 K/uL
MPV	6.7	L	7.4-10.4 fL
<b>MANUAL DIFF</b>			
TOTAL CELLS	100		#CELLS
NEUTROPHIL	69		40-80 %
BAND NEUT	11	H	0-5 %
MYELOCYTE	2	H	0-0 %
LYMPHOCYTE	10	L	20-50 %
MONOCYTE	7		2-12 %
EOSINOPHIL	1		0-5 %
<b>RBC MORPH</b>			
POIKILOCYTOSIS	2+		
ANISOCYTOSIS	2+		
TARGET CELLS	1+		

# Clinical case

## (Anemia due to Iron Deficiency and Chronic Disease 8)

24-hour Summaries from [REDACTED] 1100 through [REDACTED] 1100

Query								
IN: Oral:							1400	120
IN: IV #1:							1050	2250
IN: IVPB:								600
IN: Blood/Product:							700	
Total Intake							3150	2970
OUT: Urine:							700	2300
Total Output							700	2300
Fluid Balance							2450	670

Mainly hemodilution: the patient was with a 3-L positive balance



# Clinical case

## (Anemia due to Iron Deficiency and Chronic Disease 4)

What did we learn from this case?

- A decrease in the hemoglobin can be due to hemodilution
- This is especially true in hypovolemic patients with preexisting anemia
- The rule of thumb is that one liter of IVF can decrease the hemoglobin by as much as one gram/dL

# Treatment

## patient education

- Inform patients of the etiology of their anemia, the significance of their medical condition, and the therapeutic options available for treatment
- If no effective specific treatment of the underlying disease exists, educate patients requiring periodic transfusions about the symptoms that herald the need for transfusion
- Likewise, they should be aware of the potential complications of transfusion

# Treatment

## iron deficiency anemia

- Iron deficiency anemia is treated with changes in diet and iron supplements
- If the underlying cause of iron deficiency is loss of blood — other than from menstruation — the source of the bleeding must be located and stopped

# Treatment

## vitamin deficiency anemias

- Folic acid and vitamin C deficiency anemias are treated with dietary supplements and increasing these nutrients in diet
- If patient's digestive system has trouble absorbing vitamin B-12 from the food, he may receive vitamin B-12 injections

# Treatment

## anemia of chronic disease

- There's no specific treatment for anemia of chronic disease
- If symptoms become severe, a blood transfusion or injections of synthetic erythropoietin, a hormone normally produced by your kidneys, may help stimulate red blood cell production and ease fatigue

# Treatment

## aplastic anemia

- Treatment for aplastic anemia may include blood transfusions to boost levels of red blood cells
- Patient may need a bone marrow transplant if bone marrow can't make healthy blood cells

# Treatment

anemias associated with bone marrow disease

Treatment of anemias associated with bone marrow disease can include simple medication, chemotherapy or bone marrow transplantation

# Treatment

## hemolytic anemias

Managing hemolytic anemias includes avoiding suspect medications, treating related infections and taking drugs that suppress immune system, which may be attacking your red blood cells

Depending on the severity of anemia, a blood transfusion or plasmapheresis may be necessary

Plasmapheresis is a type of blood-filtering procedure

In certain cases, removal of the spleen can be helpful



# Treatment

## sickle cell anemia

- Treatment for sickle cell anemia may include the administration of oxygen, pain-relieving drugs, oral and intravenous fluids, blood transfusions, folic acid supplements and antibiotics
- A bone marrow transplant may be an effective treatment in some circumstances
- A cancer drug called hydroxyurea (Droxia, Hydrea) also is used to treat sickle cell anemia

# Treatment thalassemia

- Thalassemia may be treated with blood transfusions, folic acid supplements, removal of the spleen (splenectomy), a bone marrow transplant or a another drug

# Treatment

## oral iron

- Mild to moderate iron-deficiency anemia is treated by oral iron supplementation with ferrous sulfate, ferrous fumarate, or ferrous gluconate
- When taking iron supplements, stomach upset and/or darkening of the feces are commonly experienced
- The stomach upset can be alleviated by taking the iron with food; however, this decreases the amount of iron absorbed.
- Vitamin C aids in the body's ability to absorb iron, so taking oral iron supplements with orange juice is of benefit

# Treatment oral iron b)

## ORAL IRON THERAPY

- Oral iron treatment may require 3-6 months to replenish body stores.

**TABLE SHOWING SOME COMMON ORAL IRON MEDICATION.**

Preparation	Tablet size	Elemental iron per tablet	Usual Adult Dosage(per tab)
Ferrous sulfate- hydrated	325mg	65mg	3 to 4
ferrous sulfate- desiccated	200mg	65mg	3 to 4
Ferrous gluconate	325mg	36mg	3 to 4
Ferrous fumarate	100mg	33mg	6 to 8
	325mg	106mg	2 to 3

# Treatment

## injectable iron a)

- In cases where oral iron has either proven ineffective, would be too slow or where absorption is impeded (cases of inflammation), parenteral iron can be used
- The body can absorb up to 6 mg of iron daily from the gastrointestinal tract
- In many cases the patient has a deficit of over 1,000 mg of iron which would require several months to replace
- This can be given concurrently with erythropoietin to ensure sufficient iron for increased rate of erythropoiesis

# Treatment injectable iron b)

Iron Product	Iron-Repletion Dose in Patients on Chronic Hemodialysis	Iron-Repletion Dose in Patients Not on Hemodialysis
Iron dextran	100-mg IV q dialysis treatment × 10 doses	100-mg IV or IM daily × 10 doses 250-1,000-mg slow IV infusion <sup>a</sup>
Iron sucrose	100-mg IV q dialysis × 10 doses  200-mg IV q dialysis treatment × 5 doses	200-mg IV on 5 different occasions in 14 days
		500-mg slow IV infusion on Day 1 and Day 14
		300-mg, 300-mg, 400-mg IV infusion each 14 days apart
Sodium ferric gluconate	125-mg IV q dialysis treatment × 8 doses	250-mg slow IV infusion <sup>a</sup>
Ferumoxytol	510-mg IV × 2 doses 3 to 8 days apart	510-mg IV × 2 doses 3 to 8 days apart

<sup>a</sup> Not FDA approved. IM: intramuscular.  
Source: References 11-17.

# Treatment

## blood transfusions

- Blood transfusions in those without symptoms is not recommended until the hemoglobin is below 60 to 80 g/L (6 to 8 g/dL)
- In those with coronary artery disease who are not actively bleeding transfusions are only recommended when the hemoglobin is below 70 to 80g/L (7 to 8 g/dL)
- Transfusing earlier does not improve survival
- Transfusions otherwise should only be undertaken in cases of cardiovascular instability

# Treatment

## erythropoiesis-stimulating agent

- The motive for the administration of an erythropoiesis-stimulating agent (ESA) is to maintain hemoglobin at the lowest level that both minimizes transfusions and meets the individual persons needs
- They should not be used for mild or moderate anemia and are not recommended in people with chronic kidney disease unless hemoglobin levels are less than 10 g/dL or they have symptoms of anemia
- Their use should be along with parenteral iron



# Treatment

## hyperbaric oxygen

- Treatment of exceptional blood loss (anemia) is recognized as an indication for hyperbaric oxygen (HBO) by the Undersea and Hyperbaric Medical Society
- The use of HBO is indicated when oxygen delivery to tissue is not sufficient in patients who cannot be given blood transfusions for medical or religious reasons
- HBO may be used for medical reasons when threat of blood product incompatibility or concern for transmissible disease are factors

# Prognosis

- The prognosis depends on the underlying cause of the anemia
- The severity of the anemia, its etiology, and the rapidity with which it develops can each play a significant role in the prognosis
- Similarly, the age of the patient and the existence of other comorbid conditions influence outcome

# Prophylaxis

- Many types of anemia can't be prevented
- Iron deficiency anemia and vitamin deficiency anemias can be prevented by a diet that includes iron (meats, beans, lentils, iron-fortified cereals, dark green leafy vegetables, and dried fruit); folate (citrus fruits and juices, bananas, dark green leafy vegetables, legumes, and fortified breads, cereals and pasta); vitamin B-12 (meat and dairy products); vitamin C (citrus fruits, melons and berries)

# Abbreviations

- ADH - antidiuretic hormone
- EPO - erythropoietin
- FBC - full blood count
- GI - gastrointestinal
- Hct - hematocrit
- HIF-1 - hypoxia inducible factor-1
- IVF - intravenous fluid
- MCV - mean corpuscular volume
- NSAID - non-steroidal anti-inflammatory drug
- TBV - total blood volume

# Diagnostic guidelines

- [Anaemia management in people with chronic kidney disease](#)
- [Guidelines for the diagnosis and management of adult aplastic anaemia](#)
- [Guideline for the laboratory diagnosis of functional iron deficiency](#)
- [British consensus guidelines on intravenous fluid therapy for adult surgical patients \(GIFTASUP\)](#)
- [Clinical practice guidelines for evaluation of anemia](#)
- [Guidelines for the management of iron deficiency anaemia](#)
- [Significant haemoglobinopathies: guidelines for screening and diagnosis](#)